

What is claimed is:

1. A cold cathode comprising:
 - a supporting member; and
 - 5 an electron emitter supported by the supporting member and having an electron-emitting surface to emit electrons, the electron-emitting surface comprising a mixed phase of diamond phase and conductive carbon phase, and the conductive carbon phase extending in the form of a channel between the supporting member and the electron-emitting surface in the electron emitter.
2. The cold cathode as stated in Claim 1, wherein the diamond of the electron emitter includes a donor impurity.
- 15 3. The cold cathode as stated in Claim 1, wherein the diamond phase comprises a granular body, and the conductive carbon phase comprises a graphite or amorphous carbon layer, formed on a boundary surface of the granular body.
- 20 4. The cold cathode as stated in Claim 1, wherein the electron-emitting surface is made rough, and the conductive carbon is exposed on the electron-emitting surface.
- 25 5. The cold cathode as stated in Claim 1, wherein the supporting member is conductive.

6. A cold cathode discharge device comprising:
an envelope filled with a discharge gas therein; and
a cold cathode positioned in the envelope,
wherein the cold cathode comprises a supporting member and an
5 electron emitter with an electron-emitting surface to emit
electrons supported by the supporting member, the electron
emitter comprising a mixed phase of diamond phase and conductive
carbon phase, the conductive carbon extending in the form of
a channel between the supporting member and the electron-emitting
10 surface in the electron emitter, and the discharge gas including
a rare gas and mercury.

7. The cold cathode discharge device as stated in Claim 6,
wherein the discharge gas includes xenon.

15 8. The cold cathode discharge device as stated in claim 6,
wherein the diamond of the electron emitter contains a donor
impurity.

20 9. The cold cathode discharge device as stated in Claim 6,
wherein the diamond phase comprises a granular body, and the
conducting carbon phase comprises graphite or amorphous carbon
layers, formed on a boundary surface of the granular body.

25 10. The cold cathode discharge device as stated in Claim
6, wherein the electron-emitting surface is made rough, and the

conductive carbon phase is exposed.

11. The cold cathode discharge device as stated in Claim
6, wherein the cold cathode discharge device is a cold cathode
5 discharge lamp.

12. The cold cathode discharge device as stated in Claim
6, wherein the cold cathode discharge device is a plasma display
device.

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13. A cold cathode discharge device comprising:
an envelope filled with a discharge gas therein; and a cold cathode
positioned in the envelope, wherein the cold cathode comprises
a supporting member and an electron emitter with an
15 electron-emitting surface to emit electrons supported by the
supporting member, the electron emitter comprising a mixed phase
of diamond phase and conductive carbon phase, and the discharge
gas containing a gas including an element with a principal
radiation peak of 200 nanometers or less in wavelength.

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14. The cold cathode discharge device as stated in Claim
13, wherein the discharge gas includes xenon.

15. The cold cathode discharge device as stated in Claim
25 13, wherein the diamond of the electron emitter includes a donor
impurity.

16. The cold cathode discharge device as stated in Claim
13, wherein the diamond phase comprises a granular body, and
the conductive carbon phase comprises graphite or amorphous
5 carbon layers, formed on a boundary surface of the granular body.

17. The cold cathode discharge device as stated in Claim
13, wherein the electron-emitting surface is made rough, and
the conductive carbon phase is exposed.

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18. The cold cathode discharge device as stated in Claim
13, wherein the conductive carbon phase extending in the form
of a channel between the supporting member and the electron
emitting surface in the electron emitter.

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19. The cold cathode discharge device as stated in Claim
13, wherein the cold cathode discharge device is a cold cathode
discharge lamp.

20. 20. The cold cathode discharge device as stated in Claim
13, wherein the cold cathode discharge device is a plasma display
device.